Wyman

THE BLACK PLAGUE.

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THE Plague, known also as the Bubonic Plague, Levantine, Oriental, and Black Plague, and Black Death, is a disease which has ravaged from time to time the several countries of Africa, Asia, and Europe almost from time immemorial. The literature on the subject is appalling in extent, a mere enumeration of titles, with authors, covering forty pages, royal quarto size, of the *Index Catalogue* of the library of the Surgeon-General's Office, United States Army, and a score or more columns in the *Index Medicus*, published since the issue of the *Index Catalogue* in 1889.

Manetho, an Egyptian historian who lived at the beginning of the third century, B. C., described pestilences supposed to have been the plague as having occurred in the reign of the most ancient Egyptian kings. It prevailed in Athens 429–431 B. C. Thucydides has described it and had the disease, and Hippocrates noted it. It is said that Athens lost more than one-third of its population by the epidemic.

According to Rufus of Ephesus the plague prevailed in Lybia in the third century B. C., and its home was considered to be in Northern Africa. The great plague reported by Livy, who died 221 B. C., is said to have destroyed a million of persons in Africa, but it is not mentioned that it passed into Europe. Plague is also alluded to in the Bible, Zechariah xiv., 18, as peculiarly Egyptian, of which country this disease has been a great scourge.

In the Christian era it is not until the sixth century that we find the bubonic plague in Europe. In 542 it spread over Egypt, and passed to Constantinople, where it carried off 10,000 persons in one day, and in the same century appeared in Italy, and extended also along the northern coast of Africa. It prevailed in England in the seventh century.

In the fourteenth century it was introduced from the east and prevailed throughout Armenia, Asia Minor, Egypt, Northern Africa, and nearly the whole of Europe. Hecker calculates that one-fourth of the population of Europe, or 25,000,000 persons, died in all of the epidemics in the fourteenth century. It was in this century that the first measures were taken to check the spread of the plague, Venice appointing in 1348 three guardians of the public health for this purpose.

In the fifteenth century it recurred frequently in nearly all parts of Europe; in one year, 1466, the mortality reaching 40,000. The first quarantine establishment was founded in that century, in 1403, on a small island adjoining Venice.

The sixteenth century was not more free from plague than the fifteenth. In 1572, 50,000 died at Lyons. In 1576 Venice lost 70,000.

In the seventeenth century it still prevailed in Europe, though less widely than in the middle ages. In 1656 one of the most destructive of all recorded epidemics raged in Naples. It is said to have carried off 300,000 in a period of five months. The great plague of London was in 1664 and 1665. The total number of deaths in 1665, according to the bills of mortality, was 68,596 in an estimated population of 460,000, out of whom two-thirds are supposed to have fled to escape contagion.

In the eighteenth century it prevailed extensively in Europe, the most notable epidemics being in Marseilles (1720), when from 40,000 to 60,000 persons were carried off. In 1721 it appeared in Toulon and spread over Provence, and out of a population of 250,000 persons 87,659 are said to have died. Sicily was visited in 1743, namely, at Messina, where the mortality was between 40,000 and 50,000. In 1771 it broke out in Moscow, and more than 50,000 persons, nearly one-quarter of the population, were carried off.

The nineteenth century has been marked by a recession of the plague toward the East, although in 1815 it appeared on the eastern coast of Italy, confined to a small district—its last appearance in that country. An isolated epidemic appeared in Greece in 1828. It appeared in Egypt between 1833 and 1845, the last year witnessing the last plague epidemic observed in that country, and marking its great eastward recession.

There was an epidemic of extreme severity in Cairo, 1835,

during which there died a number of the inhabitants equal to the whole adult male population.

In 1840 Dalmatia, in 1841 Constantinople, and in 1843 and 1844 the eastern part of Egypt were its western boundaries.

Since 1850 the western limit of the plague is the Canary Islands (1852), while its eastern limit is the Island of Formosa, off the coast of China, where it now prevails.

Since 1850 the disease has oscillated, now east and now west, between the Red Sea and the Pacific, in China, India, Arabia, Persia, Mesopotamia, Russia, Caspian Sea, Afghanistan, Tripoli. There have been since 1850 but 19 years when it has not been recorded in one or the other of these countries. The last outbreak of plague on European soil was in 1878 and 1879 on the banks of the Volga.

As to the "plague belt," it may be said that since 1850 the disease has never travelled further north than Astrakan, about 45 degrees north, although within the present century it has visited Moscow, Norway, and Sweden, and latitudes as far as 60 degrees north. According to Cantlie, the plague belt is from 19 degrees west longitude to 121 degrees east longitude, and between 48 and 19 degrees north latitude. According to the same author, it has never been known in the Western Hemisphere or anywhere south of 19 degrees north of the equator, with the possible exception of several reported cases in Singapore, which is in 2 degrees north latitude. During the ninteenth century the belt of the plague may be roughly described as the basin of the Mediterranean, and the strip of country in Asia, from Turkey to China, running parallel to that sea; but the Mediterranean part of the belt has disappeared almost wholly within the present generation.

Formerly it was asserted that plague never appeared east of the Indus in India; nevertheless, it has been observed during the present century in more than one distinct centre in India. Since 1871, it has been heard from, particularly in China.

It should be remarked in this connection that, according to Lowson, the history of the disease in the Far East is, with the exception of Rocher's Papers, a perfect blank.

The present epidemic in Bombay is generally believed to have been introduced from Hong Kong. There was a violent epidemic in Hong Kong, in 1894, and an exacerbation of it in the same city in 1896. It was brought to Hong Kong in 1894

from Canton, distant only eight hours by steamer, and is supposed to have been introduced into Canton in 1894 by way of Thibet, from Northern India. The officially estimated mortality to February 9 is 13,221, though it is claimed that it was much greater.

This disease furnishes a striking illustration of the scientific advance of modern medicine. It was not until 1894 that positive knowledge of its true nature became known. Now, its cause, method of propagation, and the means necessary to prevent its spread are matters of scientific certainty. True, investigation is still necessary to make this knowledge complete, but enough is known to warrant the foregoing statement. All through the centuries, before and during the Christian Era, down to 1894, the subject has been enveloped in darkness, and there has been the same groping after facts, the same unsuccessful search for the true cause, the same struggle in ignorance against its ravages, on the part of physicians, sanitarians, and public officials, as has marked the history of that other great epidemic disease, cholera, now likewise robbed of its terror by science.

One has but to reflect upon the vast amount of research, thought, and labor involved in the preparation of that mass of literature previously referred to, and to the misery, disaster, and death of which it is the exponent, in order to appreciate the value of the great discovery of 1894. It is to the immortal Pasteur and to his contemporary Koch, in their establishment of bacteriology as a science, that credit is due for the possibility of this discovery, and to a Japanese physician, Dr. Kitasato, a student in the laboratory of Koch, we owe the discovery itself.

When in 1894 the plague was epidemic in Hong Kong, hundreds dying daily, great apprehension existed on the part of Japan, and accordingly Drs. Kitasato and Aoyama, with assistants, were commissioned by the Japanese Government to visit Hong Kong and there study the disease, the former to make bacteriological investigation, and the latter to report upon its clinical and pathological characteristics. The report of Kitasato announcing the discovery of the plague bacillus was published under the auspices of the University of Tokio, July 7, 1894, and may be found in full in the Annual Report of the Marine Hospital Service for 1894. Other investigators during the same year were, on the part of the English, Doctors Lowson and Cantlie;

on the part of the French Government, Dr. Yersin; of the German Government, Dr. Wilm; and of the United States, Dr. Arnold, of the Navy, to whom we are indebted for the cultures which form the basis of the experiments now being conducted in three laboratories in the United States.

It has been defined as an acute febrile disease of an intensely fatal nature, characterized by inflammation of the lymphatic glands, marked cerebral and vascular disturbances and by the presence of a specific bacillus. Although one gland alone may be clinically apparent, most, if not all, of the lymphatic glands are found to be enlarged at the post mortem examinations.

A bubo is simply an inflamed gland, and the name bubonic plague is given to the disease because of the inflammation, and sometimes suppuration, of the various lymphatic glands of the body. In from three to six days after exposure the disease makes its appearance in the individual. This period—the period of incubation—in some instances may reach nine days. The patient complains of high fever, a swelling of one or more of the lymphatic glands, and has delirium early in the attack, though seldom violent. The fever persists at least a week, and convalescence thereafter is slow. In fatal cases death usually occurs at the height of the disease, between the second and eighth day, frequently within forty-eight hours. If life is prolonged for five or six days the prognosis is better. The glands most commonly affected are those of the thigh and groin, next of the axilla, and sometimes those in the neck. The swollen gland quickly attains the size of a hen's egg, and unless death intervenes, after five or six days the gland softens and is filled with pus, which may be evacuated. In many cases of the severer type the bubo (inflamed gland) has not time to form, and then there are hemorrhages from the mucous membranes and beneath the skin hemorrhagic extravasations—the so-called petechial spots. It is probably this phenomenon, giving a dark appearance to portions of the skin, which has given the name of "black death" to the disease. Large buboes may form in a few hours after a time when a person has felt in the best of health. And, on the other hand, patients die of the disease without the appearance of a single affected gland, although the post mortem examination shows the glands to be slightly swollen, and their substance contains the plague bacillus.

According to Wilm death is generally caused by paralysis of the heart; in other cases it is from brain complications—meningitis, cerebritis, and hemorrhage.

The death rate varies in different epidemics, and is estimated at from 50 to 90 per cent. It varies, however, apparently, according to nationalities. From the official reports of the epidemic in Hong Kong, in 1894, the death rate of the several nationalities was as follows: Chinese, 93.4 per cent.; Indians, 77; Japanese, 60; Eurasians, 100, Europeans, 18.2. The relatively small percentage of deaths among Europeans is attributed to the European blood and stamina, to the early treatment and confidence in the European medical attendant.

The cause of the disease is a bacillus somewhat resembling that of chicken cholera—a small short rod, with rounded ends of the non-spore-bearing variety, characterized by its property of extremely rapid multiplication and the facility with which it enters the human organism. It is found in large numbers in the pus from the buboes, occasionally in the interior organs, in grave cases in the blood, and in the fæces. It is also found in the dust of infected houses and in the soil. While so virulent, its resisting power to chemical disinfectants is feeble, succumbing shortly in a one per cent. solution of carbolic acid, or of lime water. It dies in four days if kept at a dry heat of 60 degrees C., or 140 Fahr., or in half an hour if subjected to a temperature of 80 degrees C., 176 degrees Fahr.; and in a few minutes if subjected to a heat of 100 degrees C., 212 degrees F. As demonstrated in the Hygienic Laboratory of the Marine Hospital Service, it is easily destroyed by all of the ordinary disinfectants. On the other hand it develops easily in many culture-media at the ordinary temperature—18 to 22 degrees C., or 64.4 to 71.6 Fahr.

The length of its life, when exposed to favorable conditions outside of the human body, is as yet undetermined. Experiments on this point are being conducted in the Hoagland Laboratory in Brooklyn, and the bacillus exposed on filter paper and on blankets in a dark closet is reported as still living at the end of the thirty-eighth day. How much longer it will live is a matter of conjecture. This has an important bearing upon the quarantine measures necessary to be enforced, particularly with regard to merchandise from an infected port.

An interesting suggestion as to the cause of the prevalence of

this disease in India and China is offered by Dr. Charles W. Dabney, Jr., Assistant Secretary of Agriculture, to the effect that it may be because the people of India are so badly fed, and fed only on rice and other grains which contain very little protein. As compared with wheat, oats, Indian corn, and rye, rice, by the protein standard, is the poorest food of them all. Additional credence may be given to this theory from the fact that plague so often accompanies famine. Other conditions are known to favor it, such as overcrowding and filth; but in cities and localities where these two elements are present, while the disease has raged violently, it has been made to disappear in time; while in India, where these conditions prevail, with faulty nutrition added, the disease is persistent.

The methods by which the bacilli enter the human body are three in number—by inoculation (through an external wound or abrasion), by respiration, and by introduction into the stomach. The Japanese investigator, Aoyama, contracted the disease by inoculation incurred during a post mortem, and one of his assistants died of the disease contracted in the same manner. According to Lowson, skin to skin infection is impossible, unless the one to be infected has some wound, and the infector's skin has been soiled by fæces, blood, or the contents of buboes. The individual may contract the disease by inhaling the dust from infected houses which contains the germ; furthermore, by imbibing infected fluids or eating infected food.

It may be contracted, therefore, through one or more of the above-mentioned channels, by prolonged and intimate contact with the plague stricken, as in the case of a nurse carrying a child ill with the disease. Also by the handling of fomites—clothing, bedding, and other infected materials, and by eating with soiled or unwashed hands. Infection from bodies found in the street, in houses, or awaiting burial may take place if the clothes have been soiled by discharges. Cantlie says: "Bulard sleeping in the dead man's shirt proves nothing further than that the plague-infected garment did not generate the poison of an intensity sufficient to infect. The poison grew every moment more dilute, but a nurse carrying a child, throwing off contagion continuously, is an exposure of a different stamp." According to Lowson the poison is not given off in the ordinary respiration of a patient suffering with the disease; and sputum and saliva

from an infected person have given negative results in the only case which Lowson investigated upon this point.

The conditions favoring plague are similar to those favoring typhus fever, namely: crowd poisoning, bad ventilation and drainage, impure water supply, famine or imperfect nourishment, and inattention to sanitary requirements. It is probable of this disease, as of yellow fever, that human habitations and the ground may become so thoroughly infected as to establish endemicity. The bacillus may infect food and water, though how long it will retain its virility in water is as yet undetermined. Clothing and other personal effects, bedding, etc., may be infected through the discharges. The bacillus is not killed by drying, as is the case with the cholera bacillus, and may be carried in the dust arising through the cleansing of dwelling-houses which plague patients have occupied.

A very important element in the spread of plague in houses and localities are rats and other animals. It has been found that rats, mice, snakes, beetles, bugs, flies, dogs, and jackals are infected during an epidemic. It is significant that the purely herbiverous animals—horses, oxen, sheep, goats and rabbits—are exempt. Rats die in large numbers, and generally this phenomenon is observed in advance of the appearance of the plague among human beings. The cause of their infection is still a subject of discussion. The soil becomes infected, and a very common belief in Oriental countries is that the rat contracts the disease from miasmatic emanations from the soil, but this has never been scientifically demonstrated, and is probably incorrect. The fact that mortality among rats precedes an outbreak of plague among human beings is explained by Lowson by the fact that rats have their snouts about an inch above the floors of houses, and are more liable to inspire plague-infected dust than are human beings.

Modern science in its development of the serum therapy of disease appears to have found a thoroughly efficacious remedy in the treatment of this disease, which hitherto has maintained an average mortality of 90 per cent. A French physician, Yersin, was the first to use the serum from an immunized horse upon cases of a severe type. At Amoy, in 1896, he treated 23 cases of plague in this manner, all of whom recovered excepting two, whose cases were desperate from the outset, and upon whom treat-

ment was not begun until the fifth day of the disease. The method is similar to that of the antitoxin treatment of diphtheria, the efficacy of which is now thoroughly established.

In the prevention of the spread of the disease in a given house, all hygienic measures are necessary, such as proper sewerage, purity of water supply, isolation of the sick, disinfection of clothing and bedding, of the evacuations, and disinfection of the room, all unnecessary contact with the sick to be avoided, great care to be exercised with regard to food and drink, and according to Kitasato, after recovery the patient to be kept in isolation for at least one month. It is believed that we have a valuable aid in disinfection of rooms and houses in formaldehyd gas, which has now been established as a reliable agent superseding sulphur and which can be used without injury to metals or fabrics. Experiments with this gas as a disinfectant have been carefully made within the last year in the laboratory of the Marine Hospital Service, and the results published in the Public Health Reports issued by the Bureau. A formalin lamp for the generation of formaldehyd gas, suitable for practical use in dwellings, has been invented and successfully tested.

The advice of Kitasato that the patient should be kept isolated one month after apparent recovery is significant. Like precautions are necessary with regard to other contagious diseases, and too little attention has heretofore been paid to this very necessary precaution against the spread of contagious disease. For example, patients apparently recovered from cholera may carry within the intestinal tract the germs of the disease a variable time, possibly fourteen days. Patients who have apparently recovered from diphtheria may still be found to have the diphtheria bacillus present in the throat for many days.

As a means of preventing the spread of the disease, mention should not be omitted of the efforts of Haffkine, who has prepared, and is now using in India, a prophylactic lymph, in other words, a vaccination against the disease, which recent reports indicate is successful. Over a thousand natives and leading Europeans have already been inoculated in Bombay.

The means to be adopted when the disease becomes epidemic in a city consist, first, of a house-to-house inspection. In Bombay the Government has undertaken the inspection of 30,000 houses.

There should be prohibition of the use of dwellings unfit for habitation, and abatement of overcrowding should be required. Buildings and premises infected or suspected should be vacated for cleansing and disinfecting. The sick should be removed to hospitals or treated in their own homes, and the well who have been exposed should be removed to refuge camps. Infected bedding, clothing, etc., should be destroyed. It is the opinion of some English writers that when plague has been thoroughly fixed and established in a given city, its speedy eradication is impossible. However this may be, it is a fact that the subsidence of the plague seems to depend upon the abatement of its virulence in the due course of its evolution, and it is generally conceded that a period of seven months is necessary for the subsidence of an epidemic.

From the foregoing lines it may be readily understood how the malady may be transmitted from one country to another by travel and commerce, either overland or by sea. As with cholera, the chief element connected with its spread from India to other portions of Asia and into Europe and Africa, are the religious pilgrimages. Pilgrims from infected districts visit the shrines which are also visited by people from non-infected districts, who carry back with them the germs of the disease.

With a view to preventing the spread of the plague from India into Europe, an International Sanitary Conference has been called by the Italian Government at the instance of the Austro-Hungarian Government, which assembled at Venice, February 9th, 1897, and was expected to adjourn *sine die* about the middle of March. The representatives from the United States are Consul-General Wallace S. Jones, and Passed Assistant Surgeon H. D. Geddings, U. S. Marine Hospital Service, technical delegate. The direct interest that the United States has in the prevention of the spread of the disease into Europe may be seen from a consideration of the dangers which would threaten this country, provided the disease should become epidemic in certain European seaports, especially those from which large numbers of emigrants embark for the United States. For example, there is a large emigration from Naples, and the vessels which bring immigrants from Naples have Marseilles as their port of original departure. Thus, the infection of either port would be a matter of serious concern, and it should be remem-

bered that Marseilles is the great entrepôt on the Mediterranean of commerce from the Orient.

There are two features of this disease which are matters for serious consideration, so far as the United States is concerned; one is the fact that while the period of incubation of the ordinary plague, the violent form of the disease, is from three to six days, there is said to be another form called the ambulant, or walking form, or *pestis minor*, in which the symptoms are mild, the patients not being confined to bed. They may be afflicted for a period of from 10 to 30 days before the symptoms have developed which call attention to the disease, and it may then develop into the violent form. The other feature is the prolonged and still uncertain length of life under favorable circumstances of the plague bacillus. This has an important bearing upon the possibility of conveyance by merchandise. Personal effects are easily disinfected, but certain classes of merchandise are so difficult and expensive to disinfect as to render the measure impracticable. New merchandise plays a comparatively small role in the conveyance of contagious diseases, yet when suspected it must be disinfected or forbidden entry, until a time has elapsed covering the natural life of the bacillus.

The system of quarantine adopted by the United States is deemed sufficient to meet any emergencies. The law and regulations relate to foreign as well as to domestic ports, and require every vessel leaving a foreign port for the United States to have a bill of health signed by the consul certifying that all the requirements have been complied with. The regulations for foreign ports are such as to insure the sanitary condition of the vessel, its cargo, and passengers before sailing.

In addition to the above there is a complete and uniform system of quarantine for domestic ports. These are explicit with regard to inspection before entry, removal and treatment of the sick with contagious disease, the isolation of those who have been exposed to contagion, the disinfection of the vessel and any articles of cargo that may be infected, and finally with regard to vessels bringing immigrants, a notification to be sent to the proper state health authorities of the expected arrival within their jurisdiction of immigrants who have arrived on the infected vessel, even though all precautionary measures necessary at quarantine have been taken.

The government is well equipped with quarantine stations for the disinfection of infected vessels, and has besides several large stations where immigrants can be detained in barracks under observation, as at the Delaware Breakwater and Fisherman's Island (entrance of Chesapeake Bay), on the Atlantic coast; and Angel Island, San Francisco Bay, and Diamond Point, Washington, on the Pacific.

The Marine Hospital Service has control of twelve national quarantine stations and five inspection stations. At other ports the quarantine is maintained by State or municipal authorities, but these are obliged to conform in their practice to the regulations laid down by the Treasury Department, of which the Marine Hospital Service is a Bureau. To ensure this conformity, once or twice a year, as may be necessary, every State or local quarantine station is thoroughly inspected by a trained officer of the Marine Hospital Service. It is no longer possible, as it was prior to 1893, for a port in one State to maintain a lax quarantine to encourage its commerce, while a port in an adjoining State is enforcing proper quarantine for the exclusion of disease.

It seems impossible that the plague should ever again ravage the earth as in previous centuries.

Modern quarantine is effective to a degree. Though old fashioned and absurd as administered by some of the European countries, and imperfectly executed in others, and influenced too greatly by commercial considerations in England, it nevertheless has proven, and will continue to prove, a powerful shield against this Asiatic invasion. Even should the disease spread to certain European countries, modern sanitation of cities, the knowledge of disinfectants and improved disinfecting appliances, and modern knowledge of the disease itself would doubtless enable it to be confined within reasonable limits.

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